LimnoTech
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MEMORANDUM

SETTLEMENT COMMUNICATION
SUBJECT TO RULE 408

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PROJECT: CDAL09
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CC: Mark Ryan

SUBJECT: **Recent Issue with Spokane CE-QUAL-W2 Model**

Summary

Idaho point source dischargers to the Spokane River are investigating alternate NPDES permit limits that will comply with Washington water quality standards as informed by the TMDL. LimnoTech has been conducting simulations with CE-QUAL-W2 to assess a range of alternative loading scenarios. Prior efforts to define an acceptable scenario were confounded by the model providing inconsistent results across different computers. The repeatability issue appears to have been resolved, but we are now obtaining some results that are directly counter to the model theory. Specifically, a decrease in point source CBOD concentrations is causing a decrease in predicted lake dissolved oxygen concentrations. This situation is confounding our search for an acceptable alternative loading scenario.

The purpose of this memorandum is to document the issue we are now facing, and to provide some initial diagnostic evaluation of what may be causing it. The memorandum is divided into sections of:

- Recent simulations
- Problematic results
- Preliminary diagnostics

We will be happy to share all input and output files we have generated.

Recent Simulations

In order to more efficiently evaluate the level of Idaho treatment, we conducted a series of sensitivity runs with CE-QUAL-W2 to define the lake dissolved oxygen response to changes in individual Idaho pollutant loads (e.g. mg/l DO in lake per pound point source BOD load). These results were to be used in a spreadsheet that could quickly estimate the DO effect of different treatment alternatives, without waiting for a full CE-QUAL-W2 simulation to complete. Separate simulations were conducted to define the incremental dissolved impact of the three pollutants of concern: phosphorus, CBOD, and ammonia.

Three TP loading sensitivity analyses were conducted, corresponding to WLAs of 40 and 45 ug/l for all three sources (reduced from 50), as well as extension of increased treatment (to 50 ug/l) into January. In addition, three CBOD sensitivity runs were evaluated, corresponding to:

1. The base alternative scenario previously sent to EPA
2. Base scenario, but with Coeur d'Alene CBOD5 permit reduced from 4.5 to 4.0 mg/l

3. Base scenario, but with Coeur d'Alene CBOD5 permit reduced from 4.5 to 4.0 mg/l and Post Falls CBOD5 permit reduced from 5.6 to 5.0 mg/l

Finally, one ammonia sensitivity analysis was conducted, corresponding to a reduction of HARSB and Post Falls ammonia (HARSB permit reduced from 4 to 1 mg/l NH3; Post Falls permit reduced from 5.6 to 1 mg/l NH3).

It is emphasized that the simulations conducted above do not represent discharge limits that are acceptable to the parties. The simulations were conducted to support development of a spreadsheet that could be used by the parties to more efficiently evaluate the dissolved oxygen impact of alternate treatment scenarios.

Problematic Results

Results from each of the simulations were evaluated in terms of average dissolved oxygen for the lake model segments/times where Avista has responsibility. Problematic results were observed in the CBOD sensitivity runs, where a decrease in BOD loading caused a decrease in lake dissolved oxygen concentrations. This result is illustrated in Figure 1. The originally proposed scenario resulted in an average DO that was 0.0079 mg/l less than the TMDL scenario. The sensitivity run reducing the Coeur d'Alene CBOD5 permit from 4.5 to 4.0 mg/l improved average DO relative to the base scenario, to 0.0035 mg/l less than the TMDL. However, a further reduction of CBOD5, reducing the Post Falls permit from 5.6 to 5.0 mg/l, resulted in average DO in the lake (0.0054 mg/l less than the TMDL) that was lower than the previous sensitivity run. These results are problematic, as the model theory would indicate that reductions solely in CBOD concentration should never cause a decrease in DO. These uncharacteristic results confound selection of a final alternative.

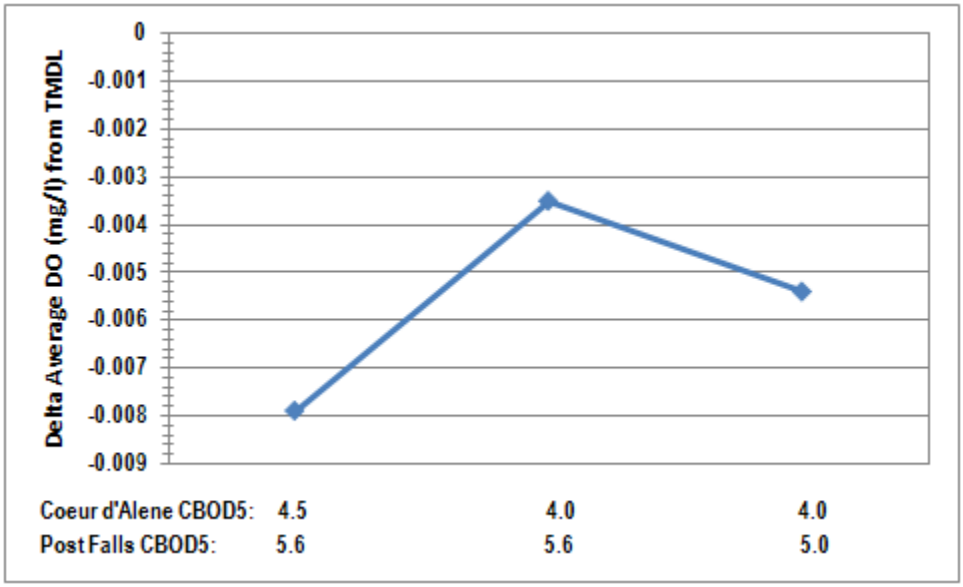

Figure 1.
Difference of Average DO from TMDL in Segments where Avista Has Responsibility

Preliminary Diagnostics

We have conducted some limited diagnostics to evaluate what might be causing these unexpected results. The diagnostics consisted of evaluating the CE-QUAL-W2 transfer files between: 1) the Idaho and Washington portions of the river, and 2) the Washington portion of the river and Lake Spokane. The Idaho-Washington transfer files for the various scenarios were first examined to evaluate how changes in Idaho point source CBOD loads were reflected at the border. Comparison of output files for two simulations which differed only in terms of Post Falls CBOD loading showed slight differences in concentrations for constituents that should be completely unaffected by Post Falls CBOD. For example, differences were observed in Coeur d'Alene CBOD concentrations at the boundary in 8 out of 8736 time steps, even though the Coeur d'Alene CBOD load was held constant across the two simulations. Differences in concentrations were also observed for TN (4 out of 8736 time steps), and TP (13 out of 8736 time steps).

The transfer files between the Washington portion of the river and Lake Spokane were then examined. Comparison of output files for two simulations which differed only in terms of Post Falls CBOD loading showed more substantial differences in concentrations than were observed at the Idaho-Washington boundary, for constituents that should be unaffected by Post Falls CBOD. For example, differences were observed in Coeur d'Alene CBOD concentrations at the boundary in 466 out of 36401 time steps. Differences in concentrations were observed for TN (173 out of 36401 time steps) and TP (643 out of 36401 time steps).

Figure 2 demonstrates that significant differences in daily average flow entering the lake (up to more than 50 m^3/sec, or 1800 cfs) were observed across the simulations. Given the previously observed sensitivity of predicted Lake Spokane DO to changes in the timing of inflows, one plausible explanation of the unexpected results is that small (unexplained) changes in instream concentrations are causing differential timing of dam releases, which are causing discrepancies in lake dissolved oxygen.

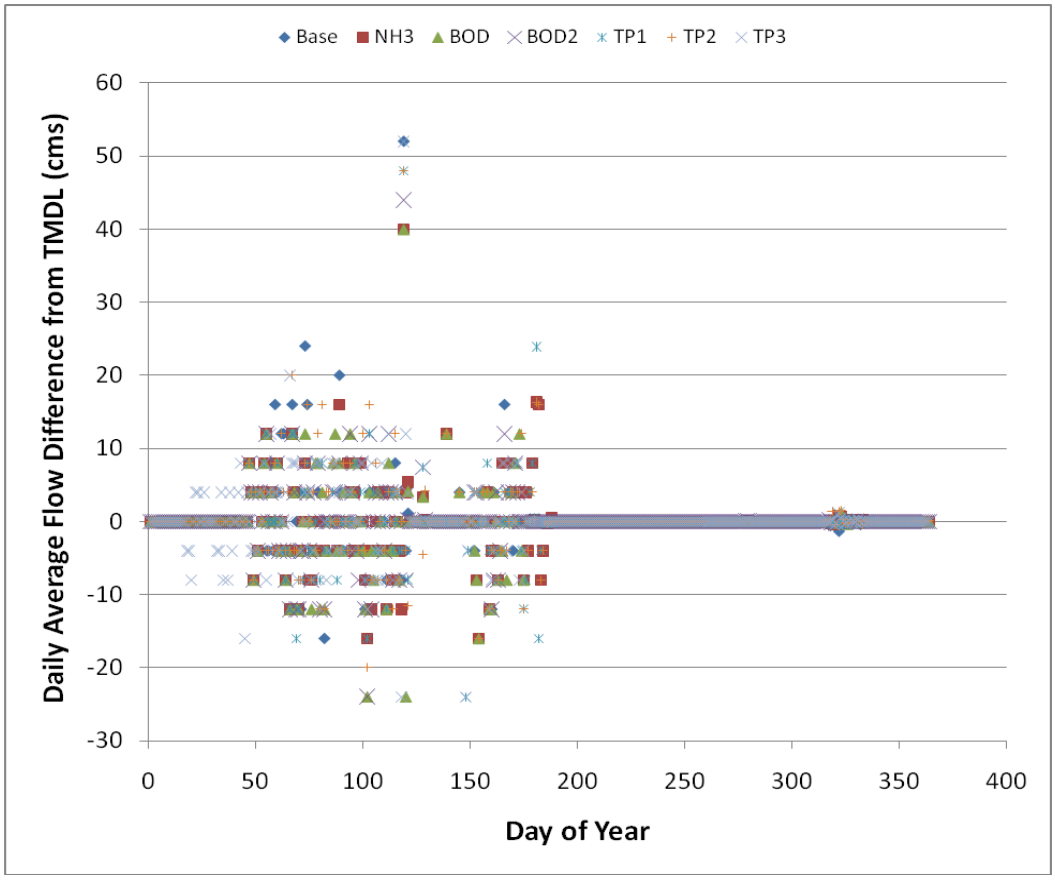

Figure 2.
Differences in Daily Average Flow Entering Lake Spokane across Simulations